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[Title of the Invention]

METHOD OF MANUFACTURING THIN FILM TRANSISTOR

[Abstract]

[Purpose] To remove crystalline defects and impurities from an element active region when a thin film transistor is manufactured.

[Constitution] An amorphous silicon film 4 is deposited on an insulating substrate 1 and an oxide film 5 is formed thereon, and ions are implanted thereinto by using a patterned photoresist film 6 as a mask to make only the amorphous silicon film 4 of a part corresponding to an element non-forming region 3 into a region having a high impurity concentration and to form a gettering layer 7. Then, the photoresist film 6 is removed and then the amorphous silicon film 4 is crystallized by laser annealing to form a polysilicon film, and at the same time, to make a region 7 having a high impurity concentration around an element forming region 2 absorb crystalline defects and impurities in the amorphous silicon film 4 of the part

corresponding to the element forming region 2. Then, the oxide film 5 is removed and then the polysilicon film (gettering layer 7) of the unnecessary part is removed by separating the elements. In this state, the polysilicon film is formed only on the element forming region 2 on the insulating substrate 1.

[Claim]

[Claim 1] A method of manufacturing a thin film transistor, said method comprising the steps of:

depositing a semiconductor thin film over an element forming region and over an element non-forming region around the element forming region;

making only the semiconductor thin film of a part corresponding to the element non-forming region into a region having a high impurity concentration to form a gettering layer;

annealing the gettering layer, whereby the crystalline defects and impurities in the semiconductor thin film of a part corresponding to the element forming region are absorbed by the gettering layer around the element forming region; and

removing the gettering layer.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application] The present invention relates to a method of manufacturing a thin film transistor.

[0002]

[Description of Prior Art] In a method of manufacturing

a transistor using a silicon wafer, good element properties can be produced by removing crystalline defects and impurities from an element active region by using a gettering technology. On the other hand, in a method of manufacturing a thin film transistor, a semiconductor thin film made of amorphous silicon, polysilicon, or the like, is deposited on an insulating substrate made of glass or the like, and then the semiconductor thin film is patterned on an element forming region by separating elements. Therefore, the gettering technology employed by the method of manufacturing a transistor using a silicon wafer can not employed.

[0003]

[Problems to be solved by the Invention] As described above, the conventional method of manufacturing a thin film transistor can not employ the gettering technology used by the method of manufacturing a transistor using a silicon wafer and hence has a problem that it can not remove the crystalline defects and impurities from the element active region and that sometimes it can not produce good element properties. It is the object of the present invention to provide a method of manufacturing a thin film transistor by which crystalline defects and impurities can be removed from an element active region.

[0004]

[Means for Solving the Problems] The present invention

provides a method of manufacturing a thin film transistor, the method including the steps of: depositing a semiconductor thin film over an element forming region and over an element non-forming region around the element forming region; making only the semiconductor thin film of a part corresponding to the element non-forming region into a region having a high impurity concentration to form a gettering layer; annealing the gettering layer, whereby the crystalline defects and impurities in the semiconductor thin film of a part corresponding to the element forming region are absorbed by the gettering layer around the element forming region; and removing the gettering layer.

[0005]

[Operation of the Invention] According to the present invention, only the semiconductor thin film of a part corresponding to the element non-forming region is made into a region having a high impurity concentration to form a gettering layer and then the gettering layer is annealed to make the gettering layer around the element forming region absorb the crystalline defects and impurities in the semiconductor thin film of a part corresponding to the element forming region, and then the gettering layer is removed. Therefore, the crystalline defects and impurities can be removed from an element active region.

[0006][Embodiments of the Invention]

FIG. 1 to FIG. 4 illustrate each manufacturing process of a thin film transistor in one embodiment in accordance with the present invention. A method of manufacturing a thin film transistor will be described with reference to these drawings.

[0007]

First, as shown in FIG. 1, an amorphous silicon film 4 is deposited on an element forming region 2 and an element non-forming region 3 around the region 2 on the surface of an insulating substrate 1 made of glass or the like. Then, an oxide film 5 is formed on the surface of the amorphous silicon film 4 by thermal oxidation. Then, a photoresist film 6 is patterned on the surface of the oxide film 5 of a part corresponding to the element forming region 2. Then, ions for performing the gettering of such as phosphorus, boron, argon, oxygen, carbon, and the like are ion-implanted by an ion implanter into the amorphous silicon film 4 of a part corresponding to an element non-forming region 3 by using the photoresist film 6 as a mask to make only the amorphous silicon film 4 of the part corresponding to the element non-forming region 3 into a region having a high impurity concentration, thereby forming a gettering layer 7. Thereafter, the photoresist film 6 is removed.

[0008]

Next, as shown in FIG. 2, the amorphous silicon film 4 is crystallized by laser annealing, whereby the amorphous

silicon film 4 is made into a polysilicon film 8 and crystalline defects and impurities in the amorphous silicon film 4 of the part corresponding to the element forming region 2 is absorbed by the gettering layer 7 around the element forming region 2. Thereafter, the oxide film 5 is removed and then the unnecessary polysilicon film 8 of the part corresponding to the element non-forming region 3, that is, the gettering layer 7 is removed. Therefore, in this state, the polysilicon film 8 is formed only on the element forming region 2 on the surface of the insulating substrate 1.

[0009]

Next, as shown in FIG. 3, a gate insulating film 9 made of silicon oxide, silicon nitride or the like is formed on the whole surface. Then, a gate electrode 11 made of aluminum is patterned on the surface of the gate insulating film 9 of a part corresponding to the channel region 10 of the polysilicon film 8. Then, ions for forming a source and a drain, such as phosphorus, boron, or the like, are implanted thereinto by an ion implanter by using the gate electrode 11 as a mask to form a source region 12 and a drain region 12 in the polysilicon film 8 on both sides of the gate electrode 11.

[0010]

Next, as shown in FIG. 4, an interlayer insulating film 13 made of silicon oxide, silicon nitride or the like is formed on the whole surface. Then, a contact hole 14 is formed in

the interlayer insulating film 13 and in the gate insulating film 9 of a part corresponding to each of the source region 12 and the drain region 12. Then, a source electrode 15 of and a drain electrode 15, each of which is made of aluminum and connected to the source region 12 or the drain region 12 via the contact hole 14, are patterned on the surface of the interlayer insulating film 13. A thin film transistor is manufactured in these ways.

[0011]

In the thin film transistor manufactured in these ways, only the amorphous silicon film 4 of the part corresponding to the element non-forming region 3 is made into a region having a high impurity concentration to form a gettering layer 7 and then the gettering later 7 is annealed to make the gettering layer 7 around the element forming region 2 absorb the crystalline defects and impurities in the amorphous silicon film 4 of the part corresponding to the element forming region 2, and then the gettering layer 7 is removed. Therefore, the crystalline defects and impurities can be removed from element active region and hence a good element property can be produced. Further, one annealing process can crystallize the amorphous silicon film 4 to make it into a polysilicon film 8 and at the same time can make the gettering layer 7 around the element forming region 2 absorb the crystalline defects and impurities of the amorphous silicon film 4 of the part corresponding to

the element forming region 2, and the unnecessary polysilicon film 8 of the part corresponding to the element non-forming region 4, that is, the gettering layer 7 is removed by separating the elements, which can prevent the number of processes from increasing. Still further, if the same ions as are used for forming the source and the drain are used as ions for gettering, the ions for gettering can also be implanted with the same ion implanter as is used for forming the source and the drain.

[0012]

In this regard, in the embodiment described above, although the amorphous silicon film 4 deposited on the surface of the insulating substrate 1 is crystallized to make the polysilicon film 8, the polysilicon film may be deposited directly on the surface of the insulating substrate 1. Also, instead of the ion implanter, a thermal diffusion method may be used, and instead of a laser annealing method, a high temperature heat treatment may be performed. Further, this method can be applied not only to a coplanar type thin film transistor, but also to a stagger-type thin film transistor.

[0013]

[Effects of the Invention] As described above, according to the present invention, only a semiconductor thin film of the part corresponding to the element non-forming region is made into a region having a high impurity concentration to make

a gettering layer and then the gettering layer is annealed to make the gettering layer around the element forming region absorb the crystalline defects and impurities in the semiconductor thin film of the part corresponding to the element forming region, and then the gettering layer is removed. Therefore, the crystalline defects and the impurities can be removed from the element active region and hence good element properties can be produced.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a cross-sectional view showing a state in which when a thin film transistor in one embodiment of the present invention is manufactured, an amorphous silicon film and an oxide film are formed on an insulating substrate and further ions for gettering are implanted into the surface thereof by using a patterned photoresist film as a mask to form a gettering layer.

[FIG. 2]

FIG. 2 is a cross-sectional view showing a state in which when the same thin film transistor is manufactured, the photoresist film is removed and then the amorphous silicon is crystallized by laser annealing to make the amorphous silicon into a polysilicon film and to make the gettering layer around an element forming region absorb the crystalline defects and impurities in the amorphous silicon film of the part

corresponding to the element forming region.

[FIG. 3]

FIG. 3 is a cross-sectional view showing a state in which when the same thin film transistor is manufactured, the oxide film and the unnecessary polysilicon film (gettering layer) are removed and then a gate insulating film and a gate electrode are formed, and ions for forming a source and a drain are implanted thereinto by using the gate electrode as a mask to form the source and the drain.

[FIG. 4]

FIG. 4 is a cross-sectional view showing a state in which when the same thin film transistor is manufactured, an interlayer insulating film, a contact hole, a source electrode, and a drain electrode are formed.

[Brief Description of the Reference Symbols]

1-insulating substrate, 2-element forming region, 3-element non-forming region, 4-amorphous silicon film, 5-oxide film, 7-gettering layer, 8-polysilicon film

FIG. 1-ions for gettering, FIG. 2-laser annealing, FIG. 3-ions for forming a source and a drain

層７とした後アニールすることにより、素子形成領域２に対応する部分のアモルファスシリコン膜４における結晶欠陥や不純物等をその周囲のゲッタリング層７に吸収させ、この後ゲッタリング層７を除去しているので、結晶欠陥や不純物等を素子活性領域から除去することができ、ひいては良好な素子特性を得ることができる。また、１回のアニール工程により、アモルファスシリコン膜４を結晶化してポリシリコン膜８とすると同時に、素子形成領域２に対応する部分のアモルファスシリコン膜４における結晶欠陥や不純物等をその周囲のゲッタリング層７に吸収させることができ、また素子分離により、非素子形成領域４に対応する部分の不要なポリシリコン膜８つまりゲッタリング層７を除去しているので、工程数がなるべく増加しないようにすることができる。さらに、ゲッタリング用のイオンとしてソース・ドレイン形成用のイオンと同じイオンを用いることにすれば、ゲッタリング用のイオンの注入をソース・ドレイン形成用のイオン注入装置によって行うこともできる。

【００１２】なお、上記実施例では、絶縁基板１の上面に堆積したアモルファスシリコン膜４を結晶化してポリシリコン膜８としているが、これに限らず、絶縁基板の上面にポリシリコン膜を直接堆積するようにしてもよい。また、イオン注入装置の代わりに、熱拡散法を用いてもよく、またレーザアニールの代わりに、高温熱処理を施してもよい。さらに、コプラナ型の薄膜トランジスタに限らず、スタガ型の薄膜トランジスタにも適用することができる。

【００１３】

【発明の効果】以上説明したように、この発明によれば、非素子形成領域に対応する部分の半導体薄膜のみを高不純物領域化してゲッタリング層とした後アニールすることにより、素子形成領域に対応する部分の半導体薄膜における結晶欠陥や不純物等をその周囲のゲッタリング層に吸収させ、この後ゲッタリング層を除去しているので、結晶欠陥や不純物等を素子活性領域から除去することができ、ひいては良好な素子特性を得ることができる。

【図面の簡単な説明】

【図１】この発明の一実施例における薄膜トランジスタの製造に際し、絶縁基板の上面にアモルファスシリコン膜および酸化膜を形成し、さらにその上面にパターン形成したフォトレジスト膜をマスクとしてゲッタリング用のイオンを注入してゲッタリング層を形成した状態の断面図。

【図２】同薄膜トランジスタの製造に際し、フォトレジスト膜を除去した後レーザアニールすることにより、アモルファスシリコン膜を結晶化してポリシリコン膜とすると共に素子形成領域に対応する部分のアモルファスシリコン膜における結晶欠陥や不純物等をその周囲のゲッタリング層に吸収させた状態の断面図。

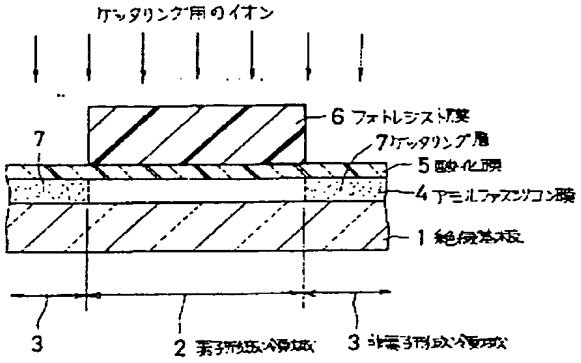
【図３】同薄膜トランジスタの製造に際し、酸化膜および不要なポリシリコン膜（ゲッタリング層）を除去した後ゲート絶縁膜およびゲート電極を形成し、さらにゲート電極をマスクとしてソース・ドレイン形成用のイオンを注入してソース・ドレイン領域を形成した状態の断面図。

【図４】同薄膜トランジスタの製造に際し、層間絶縁膜、コンタクトホールおよびソース・ドレイン電極を形成した状態の断面図。

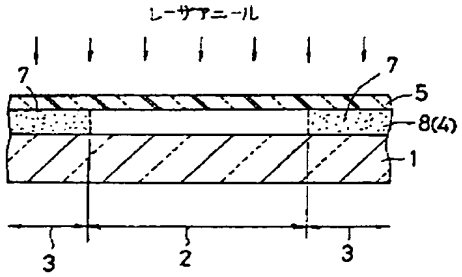
【符号の説明】

１　絶縁基板
２　素子形成領域
３　非素子形成領域
４　アモルファスシリコン膜
５　酸化膜
７　ゲッタリング層
８　ポリシリコン膜

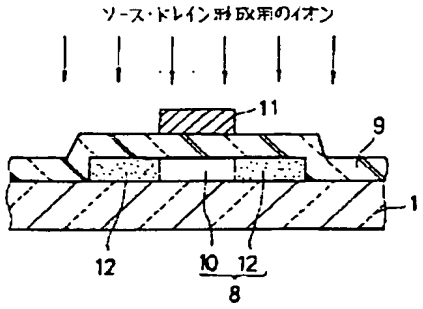
【図１】



【図２】



【図３】



【図４】